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Research Article

Rhododendron luohanbaense (Ericaceae), a new species from northeast Yunnan, China

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Abstract

Rhododendron luohanbaense, a new species of Ericaceae, is described from Zhaotong City in northeastern Yunnan Province, China. Morphologically, it is most similar to both *R. pachytrichum* and *R. maculiferum* and can be classified into the subgen. *Hymenanthes* sect. *Pontica* subsect. *Maculifera*. However, it can be easily distinguished by markedly smaller and narrower leaves with acuminate apex, abaxial midribs densely covered with woolly indumentum, yellowish-green corollas speckled with green or purple dots, inflorescences bearing up to 7 flowers, flowers with ovary densely pilose, capsule densely brown setose. Phylogenomic evidence, based on a coalescent-based species tree reconstructed from 5358 single-copy nuclear orthologous genes, also supports recognition of the new taxon.

Key words: Ericaceae, new taxon, nuclear orthologous genes, phylogeny

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Introduction

The genus *Rhododendron*, first described by Linnaeus (1753: 392), comprises more than 1000 species worldwide. China exhibits a remarkable diversity, with more than 600 species documented (Geng 2014). Even after the publication of the Flora of China (Fang et al. 2005), new species of *Rhododendron* continue to be discovered and reported from China in recent years (Tian et al. 2019; Deng et al. 2025; Zhao et al. 2025).

The southwestern region of China, particularly the Provinces of Yunnan, Sichuan, Xizang, and Guizhou, represents a major center of distribution and diversity for this genus. The Wumengshan National Nature Reserve is located in northeastern Yunnan Province, spanning a critical floristic ecotone at the convergence of the Yunnan-Guizhou Plateau and the Sichuan Basin. Owing to its distinctive geographic setting, complex topography, and diverse altitudinal

climates, the reserve harbors a wide array of vegetation types, intricate floristic compositions, and rich biodiversity (Zhao et al. 2024). More than 2000 species of vascular plants have been recorded within the reserve. The montane climate of the reserve, characterized by relatively low mean annual temperatures (6–15 °C) and high relative humidity (>85%), creates cool mesic environments and ecological niches that are highly suitable for rhododendrons.

Three new species in the genus *Rhododendron* were discovered during a series of field surveys conducted in the nature reserve over the years, i.e. *R. rimicola* X.L. Tian, Y.P. Ma & J. Nielsen (Tian et al. 2019), *R. kuomeianum* Y.H. Chang, J. Nielsen & Y.P. Ma (Chang et al. 2021) and *R. wumengense* Y.L. Zhao & D.T. Liu (Zhao et al. 2025). Subsequent surveys revealed a further taxon exhibiting morphological divergence from previously recorded *Rhododendron* species. However, flowering specimens remained elusive until the field survey in May 2025, when flowering individuals were finally observed and their morphology was measured and described *in situ*. Based on comprehensive morphological evidence, we propose that it represents an undescribed species. To ascertain the taxonomic independence of the proposed new species, we also performed phylogenomic analyses based on genome resequencing data. The resulting species tree provided preliminary molecular evidence supporting its recognition as a new taxon.

Methods

Materials collection and morphological comparison

In May 2025, flowering individuals were collected from Luohanba in Daguan County. Fresh leaf vouchers were prepared, dehydrated in sealed bags with silica gel, and stored as molecular vouchers. To assess the distribution and population status of the newly discovered taxon, we performed repeated field surveys in its type locality and the surrounding area of the Nature Reserve in Daguan and Yiliang Counties. Additionally, we carried out a comprehensive literature examination (Fang et al. 2005; Geng 2014) and critical examination of relevant herbarium specimens from the online database CVH (http://www.cvh.ac.cn) and the JSTOR Global Plants (http://plants.jstor.org).

DNA sequencing and phylogenetic analysis

Total genomic DNA of the new species was extracted using the modified CTAB method (Doyle and Doyle 1987). Sequencing libraries were prepared and resequenced in paired-end mode on the DNBSEQ-T7 platform (Wuhan Benagen Co., Ltd.). In addition, whole genome sequencing (WGS) data of six species from *Rhododendron* subsect. *Maculifera* and *Vaccinium oldhamii* (Ericaceae) were retrieved from the Genome Sequence Archive (GSA) database of the NGDC (National Genomics Data Center) and the NCBI (National Center for Biotechnology Information) (Table 1).

The obtained raw WGS data were first processed with fastp v0.23.4 (Chen 2023) using the default parameters to control quality. Using 5358 single-copy nuclear orthologous genes previously screened from the genus *Rhododendron* (Mo et al. 2025) as references, putative single-copy orthologous genes were assembled from the WGS data with HybPiper v2.3.3 (Johnson et al. 2016)

Table 1. Source of materials studied and accession numbers.

Taxon	Accession ID
R. pachytrichum	CRR361043
R. maculiferum	CRR360969
R. ochraceum	CRR360931
R. strigillosum	CRR360971
R. longesquamatum	CRR361027
R. pachyphyllum	CRR361110
Vaccinium oldhamii	SRR29122482

under default parameters. Gene sequences were extracted for each sample using the "retrieve_sequences" module in HybPiper. Sequences were aligned with MAFFT v7.526 using the "auto" option. Gene trees were constructed using IQ-TREE v3.01 (Nguyen et al. 2015) under the "MFP" option with 1000 bootstrap replicates. Newick Utilities (Junier and Zdobnov 2010) were used to prune branches in gene trees with bootstrap values < 30. Species trees were inferred from the resulting gene trees with ASTRAL v1.23.4.6 (Zhang et al. 2018) under default settings. *Vaccinium oldhamii* was selected as the outgroup to re-root the species tree in FigTree v1.4.4 (https://github.com/rambaut/figtree). Finally, the species tree was visualized and displayed using FigTree.

Results and discussion

On molecular basis, after branch pruning, 5357 gene trees were obtained and subsequently used to reconstruct the species tree. The new species formed a stable, fully supported (LPP = 1) clade that was sister to a closely related group comprising *R. maculiferum*, *R. pachytrichum* and *R. strigillosum*. It represents an independent, fully supported (LPP = 1) monophyletic lineage. This phylogenetic placement rules out the possibility that the new species represents a population of either *R. maculiferum* or *R. pachytrichum* (Fig. 1). However, further research based on additional specimens is needed to clarify its exact phylogenetic placement.

Taxonomic treatment

***Rhododendron luohanbaense* Y.L.Zhao & D.T.Liu, sp. nov.**
urn:lsid:ipni.org:names:77379003-1
Figs 2, 3

Diagnosis. *Rhododendron luohanbaense* resembles *R. pachytrichum*, but can be distinguished by its markedly shorter leaves (4–7 cm vs. 7–14 cm), the densely woolly leaf abaxial midrib (vs. curved floccose-tomentose mainly near base), yellowish-green corollas (vs. white to pink) and the densely long brown or rufous setose capsule (vs. ferruginous-tomentose or glabrescent) (Figs 2, 3, Table 2). The new species is also most similar to *R. maculiferum*, but differs significantly in having markedly narrower leaves (2–3 cm vs. 2.5–4.2 cm) with acuminate apexes (vs. obtuse or rounded apexes), the leaf abaxial midrib entirely covered with dense woolly hairs (vs. densely tomentose under the middle part), yellowish-green to pale green corollas, and 4–7 flowers (vs. 7–10 flowers), as well as a densely long brown or rufous setose capsule (vs. rufous-tomentose or

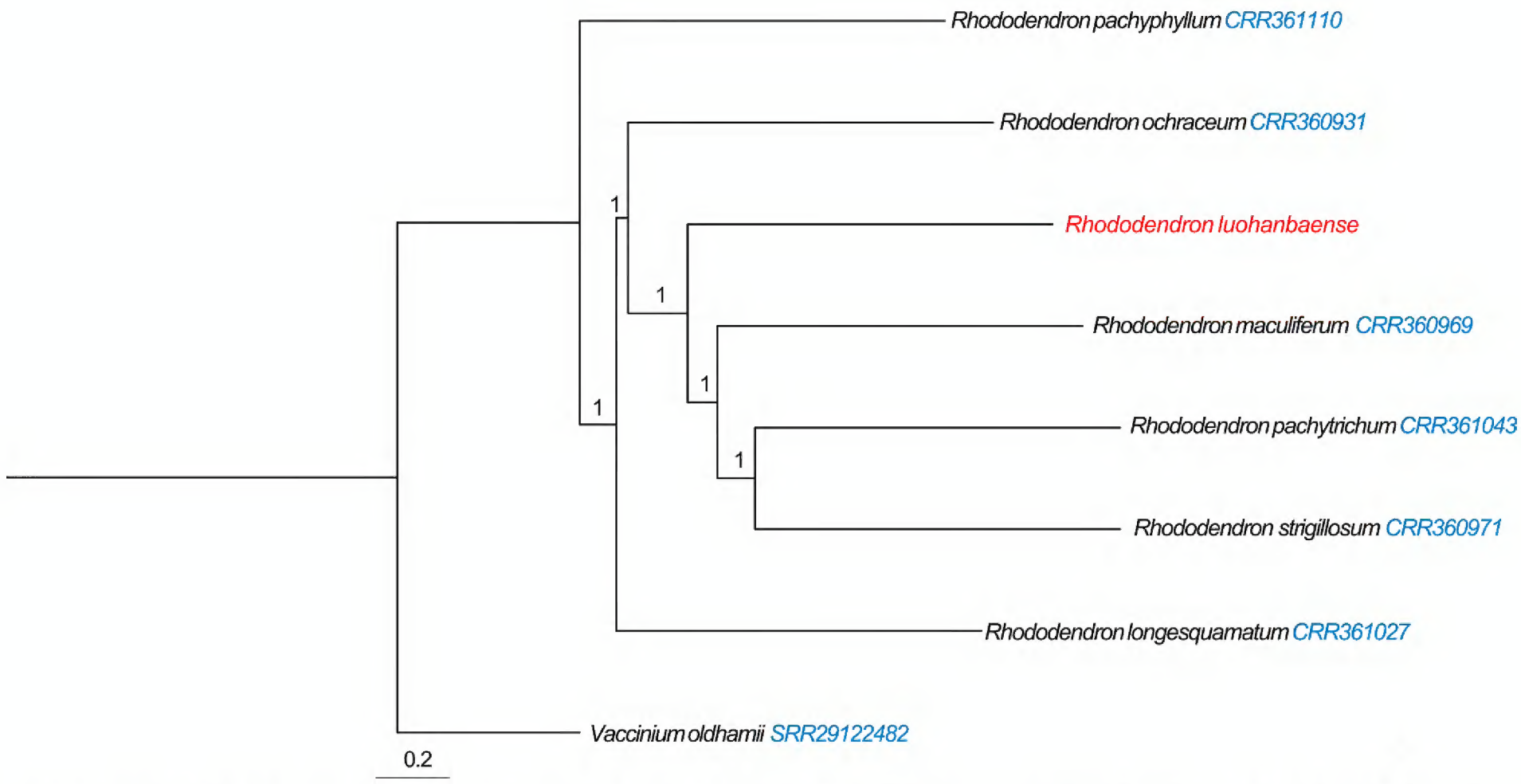

Figure 1. ASTRAL species tree of *Rhododendron luohanbaense* and related taxa. Note: Node values represent local posterior probabilities (LPP).

glabrous) (Figs 2, 3, Table 2). More detailed morphological differences among the three similar species are shown in Table 2.

Type. CHINA • Yunnan, Zhaotong City, Daguan County, Tianxing Town, Lvnan Village, Luohanba, 27°53'58.16"N, 104° 6'9.87"E, elev. ca. 2048 m, in subtropical montane evergreen broadleaved forest, under forest, 15 May 2025, *Y.L. Zhao*, *D.T. Liu*, *C.S. Gu* & *Z.H. Liao WMS033* (holotype KUN, isotype KUN).

Description. ***Shrub or small tree, evergreen.*** 1–8 m tall, bark brown, smooth. ***Young branches*** green, densely covered with white tomentose, aging to brown and gradually glabrous. ***Leaves*** subleathery, clustered subverticillately at branch tips; ***petiole*** 1–1.2 cm long, white-tomentose when young, rapidly brown-black tomentose-setose; ***leaf blade*** elliptic-lanceolate to ovate-lanceolate, 4–7 cm long, 2–3 cm wide, base orbicular to cordate, margin ciliate (white when young and black when old), apex acuminate (shortly acuminate); ***adaxial surface*** green, glabrous except at midrib base, grooved; ***abaxial surface*** pale green, midrib prominent, densely covered with long white woolly when young, gray to brown when mature; ***lateral veins*** 9–12 pairs, sparsely brown-woolly. ***Inflorescence*** a terminal short racemose-umbel, 4–7 flowered; ***rachis*** 1–1.8 cm, glabrous; ***pedicels*** green or brown, 1–2.5 cm long, densely white-pilose. ***Calyx*** ca. 1.5 mm, lobes 5, sharply triangular, densely white-pilose. ***Corolla*** campanulate, 2.2–3.5 cm long, 2.8–4.5 cm in diameter, yellowish-green to pale green, internally with yellow-green, brown, purplish-red flecks, lacking or with a basal blotch; ***lobes*** 5, orbicular, 0.7–1.1 cm long, 1.4–1.8 cm wide, apex emarginate. ***Stamens*** 10, unequal, 1–2.8 cm long; ***filaments*** glabrous; anthers oblong, 1–2 mm long, purplish-black. ***Ovary*** narrowly conical, 4–5 mm long, densely covered with long-white-pilose; ***style*** 2–3 cm long, glabrous; ***stigma*** small, greenish or pale yellow, ca. 1 mm wide. ***Capsule*** cylindrical, ca. 1 cm long, diameter 3–4 mm, straight or slightly curved, densely covered with long brown or rufous setose.

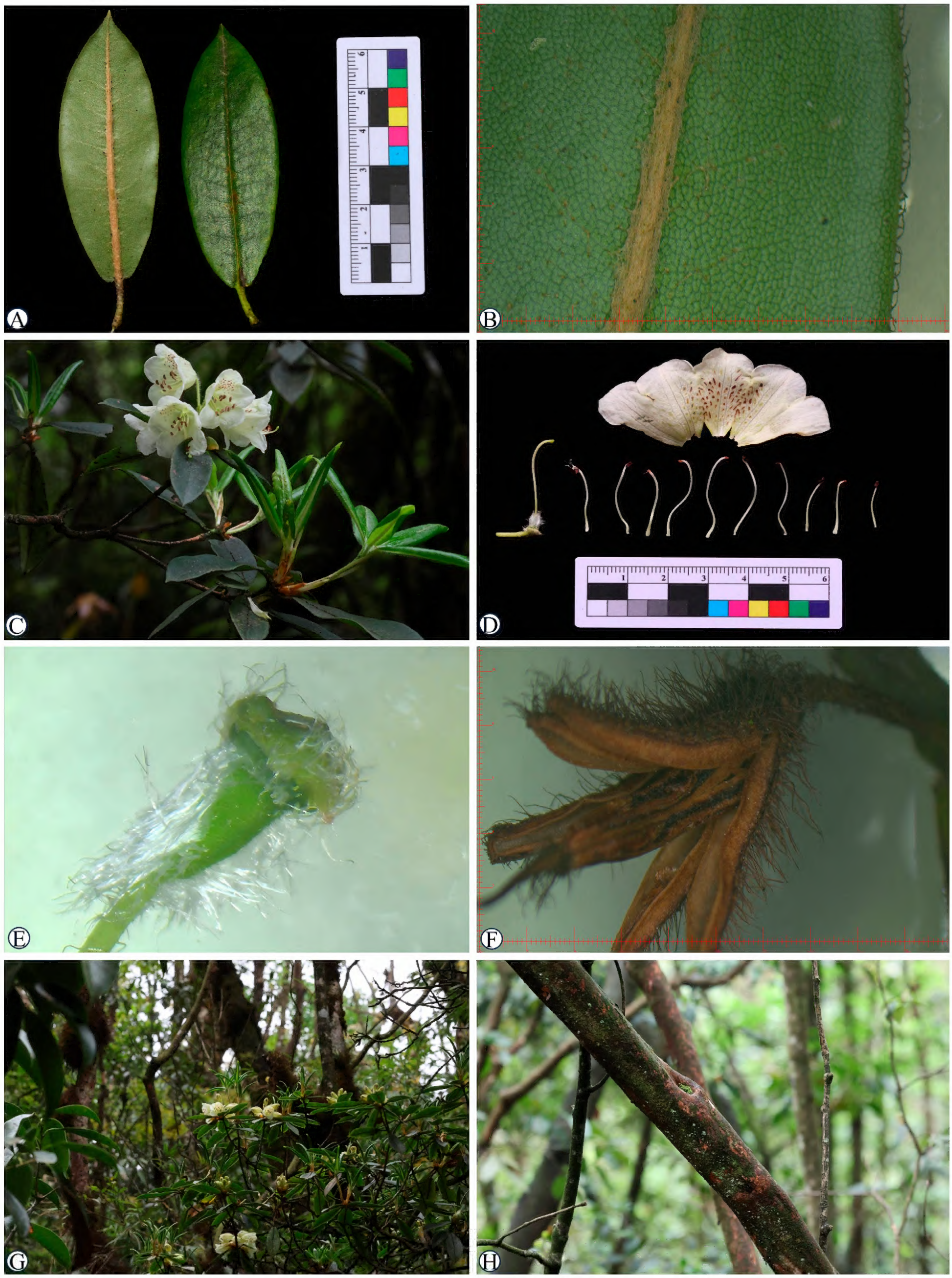

Figure 2. *Rhododendron luohanbaense* Y.L.Zhao & D.T.Liu, sp. nov. **A.** Leaf; **B.** Leaf, abaxial midrib; **C.** Flowering branch; **D.** Dissection of flower; **E.** Ovary; **F.** Opened capsule; **G.** Habitat; **H.** Stem.

Figure 3. *Rhododendron luohanbaense* (**A, D, G, J**), *Rhododendron pachytrichum* (**B, E, H, K**) and *Rhododendron maculiferum* (**C, F, I, L**). **A–C.** Leafy branches; **D–F.** Abaxial midrib of leaves; **G–I.** Flowering branch; **J–L.** Capsule.

Phenology. *Rhododendron luohanbaense* flowers from April to May and fruits in November.

Etymology. The specific epithet derives from the Luohanba, the subzone of the Yunnan Wumengshan National Nature Reserve where the holotype was collected; Chinese mandarin: luó hàn bà dù juān (罗汉坝杜鹃).

Distribution and ecology. Currently, *Rhododendron luohanbaense* is primarily distributed in Daguan and Yiliang Counties, Zhaotong City, northeastern Yunnan Province, China (Fig. 4). It grows at elevations between 1820 m and 2050 m in subtropical montane evergreen broad-leaved forests and evergreen deciduous broad-leaved mixed forests.

Preliminary conservation status. *Rhododendron luohanbaense* occurs in multiple localities within national nature reserves where human disturbance

Table 2. Comparison of *Rhododendron luohanbaense*, *R. pachytrichum* and *R. maculiferum*.

Characters	*R. luohanbaense*	*R. pachytrichum*	*R. maculiferum*
Leaf size	4–7 × 2–3 cm	7–14 × 2–4.5 cm	4–11 × 2.5–4.2 cm
Leaf apex	acuminate	obtuse to acuminate	obtuse or rounded
Leaf abaxial midrib	densely long woolly from base to apex	curved floccose-tomentose near base	densely tomentose near base
Petiole length	1–1.2 cm	1–1.5 cm	1.4–2.5 cm
Lateral veins	9–12	14–19	12–17
Inflorescence	4–7	7–10	7–10
Corolla shape	campanulate	campanulate	open campanulate
Corolla size	2.2–3.5 × 2.8–4.5 cm	3–4.5 × 3–4.2 cm	3.7–4 × 3.8–4.2 cm
Corolla color	yellowish-green to pale green	white to pink	white to pale pink
Filament	glabrous	white-pilose at base	white-pilose at base
Ovary	densely long-white-pilose	densely rufous-tomentose	slightly pale-brown-tomentose or glabrous
Capsule	densely long brown or rufous setose	ferruginous-tomentose or glabrescent	rufous-tomentose or glabrous
Distribution	NE Yunnan	Sichuan, Chongqing, NE Yunnan, etc.	Sichuan, SW Shaanxi, S Gansu, W Hubei, and Guizhou, etc.
Elevation	1820–2050 m	1700–3500 m	1600–3400 m
Flowering	April–May	April–May	May–June
Fruiting	November	August–September	September–October

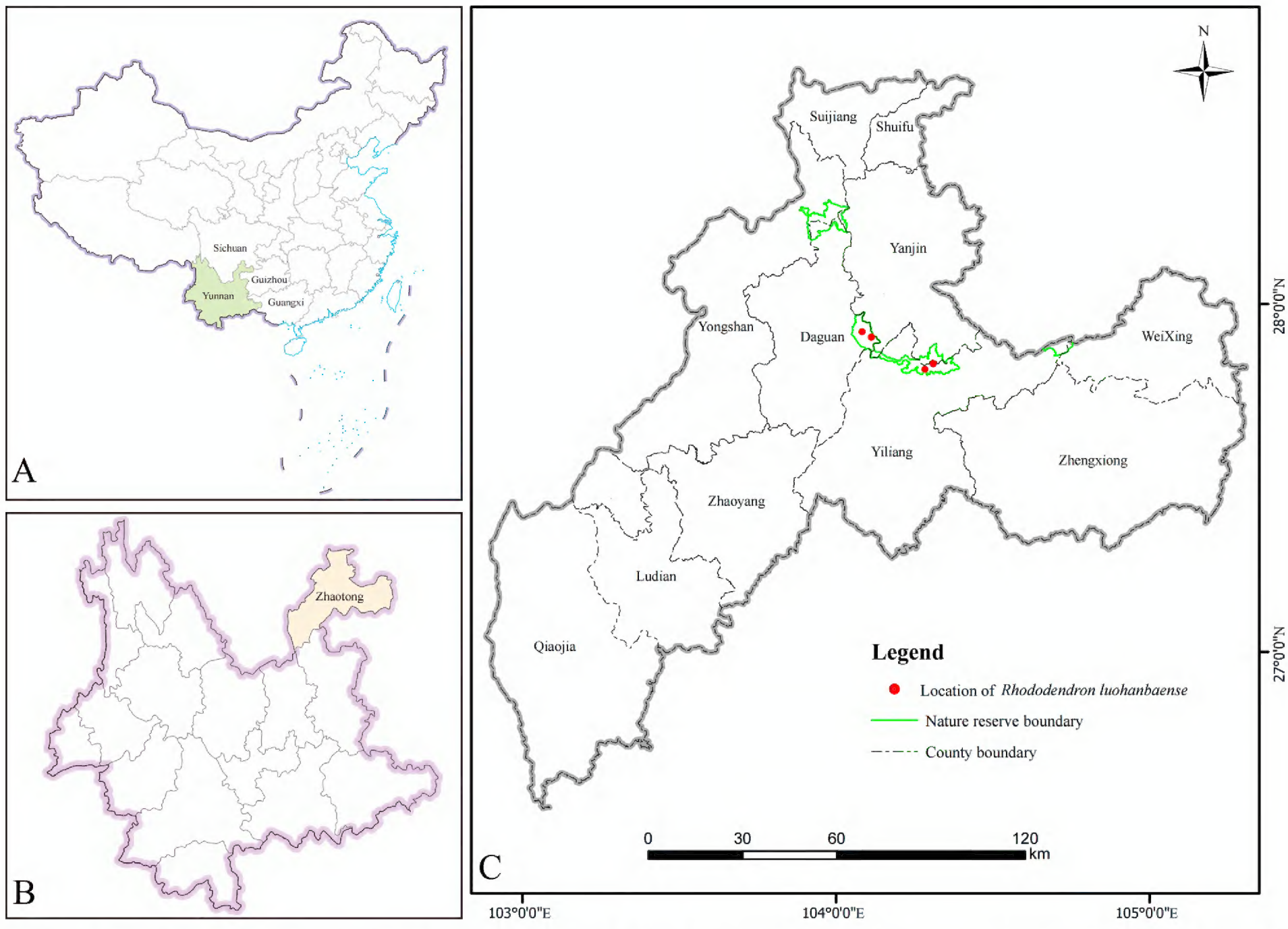

Figure 4. Geographic distribution of *Rhododendron luohanbaense* in Wumengshan National Nature Reserve. **A.** China; **B.** Yunnan Province; **C.** Zhaotong City.

is limited. Currently, four distribution sites are known in Daguan and Yiliang Counties in protected areas. The estimated extent of occurrence (EOO) is approximately 85 km^2. Thus, the conservation status is preliminary classified as Endangered (EN) according to the IUCN Red List Categories and Criteria (IUCN 2001).

Notes. Based on gross morphological characters comparison, the plants recently collected from Luohanba belong to subsection *Maculifera* (Fang et al. 2005). This assignment is supported by the diagnostic features of this subsection: abaxial leaf indumentum denser along the midrib, ovary densely pilose, and campanulate corolla internally with flecks or blotch. Within this subsection, the new species is most similar to *R. pachytrichum* and *R. maculiferum* in sharing denser indumentum along the abaxial leaf midrib, sparse inflorescence, and campanulate corolla (Fig. 3).

Except for the difference in the Diagnosis section. The three species show clear divergence in distribution, elevational range, and phenology. *R. luohanbaense* is currently known only from NE Yunnan at mid-elevations (1820–2050 m). In contrast, *R. pachytrichum* occupies a broader elevational range (1700–3500 m) across Sichuan, Chongqing, Shaanxi. *R. maculiferum* has a wide distribution spanning Shaanxi, Gansu, Hubei, Sichuan, Guizhou.

Additional specimens examined (*paratype*). CHINA • Yunnan, Zhaotong City, Yiliang County, Xiacaoba Town, Houhe, 27°49'27.2847"N, 104°18'08.9662"E, elev. ca. 1923 m, in subtropical evergreen broad-leaved forest, under forest along valley, 19 May 2025, *Y.L. Zhao*, *D.T. Liu*, *C.S. Gu WMS053* (KUN).

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Use of AI

No use of AI was reported.

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Author contributions

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Data availability

All the sequencing data used in this study are publicly available in the National Genomics Data Center (NGDC) and the National Center for Biotechnology Information (NCBI). The resequencing data for *Rhododendron luohanbaenseare* was held in reserve for a related study.

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